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HUMAN RESOURCES

LABORATORY

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**NAVIGATOR-OBSERVER UTILIZATION FIELD
FLYING SPECIALTIES STUDY
FINAL REPORT**

By

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Williams Air Force Base, Arizona

April 1972



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AIR FORCE SYSTEMS COMMAND

BROOKS AIR FORCE BASE, TEXAS

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FLYING TRAINING DIVISION
AIR FORCE HUMAN RESOURCES LABORATORY
AIR FORCE SYSTEMS COMMAND
Williams Air Force Base, Arizona

FOREWORD

This study represents research in support of Project 1123, Flying Training Development, Task 1123-06, Task Analysis and Inventory for Flying Training Program Development. Dr William V. Hagin was project scientist and Major Robert E. MacArgel was task scientist. Lt Colonel Dan D. Fulgham assisted in technical direction. This effort covered the period of time between February 1971 and April 1972.

The USAF has directed that all Air Force training programs be redesigned to reflect the concepts of the Instructional Systems Development (ISD) approach to training. Data, results, and recommendations developed in this study are immediately useful to the navigator program managers in that the ISD requirement was a guideline throughout. It should be noted that the effort reported here meets only parts of the first three requirements of ISD, albeit the more rigorous and time consuming ones. It is hoped that the users of this study will expand on it, and, in particular, take action to insure that the data base remains a viable and useful tool for future training program designers.

Special credits go to Colonel John R. Burgess and Lt Colonel Anthony L. Giuliano of ATC/DON, Lt Colonel Robert O. McCartan, AFDPTTF, Lt Colonel Robert Gerry, AFDPXYR, Lt Colonel Charles A. Walden, 3535NIW/DNTS, and Dr Don Meyer, ATC/XPTD, without whose assistance and cooperation this study could not have been performed.

GEORGE K. PATTERSON, Colonel, USAF
Commander

ABSTRACT

The Navigator-Observer Utilization Field Flying Specialties Study was performed in the context of the Instructional Systems Development (ISD) approach. The study was designed to identify the future role and training requirements for Navigator-Observers through 1990. Objectives accomplished by the study were:

- Determine present and future roles of Navigator-Observers
- Identify and analyze operational task requirements
- Identify common and non-common operational tasks
- Develop training objectives based upon all tasks
- Validate present Navigator-Observer training requirements
- Identify further research and development requirements.

Role information was used in the development of behavioral objectives for projected training tasks. Role information can also be used in policy decisions regarding future navigator training program design. Task and commonality analysis data formed the nucleus of the first computerized navigator-observer data base. Among the most important uses of such information are the development of trainee selection criteria, design of training tasks, curriculum design, selection of methods and media, and development of detailed performance measures and tests. Training requirements in the form of behavioral objectives can provide the cornerstone for future Navigator-Observer training program design according to ISD. Approximately 80% of present Navigator-Observer training requirements were partially or fully validated by study derived data. Recommendations for follow-up studies are presented.

TABLE OF CONTENTS

	<u>Page</u>
Foreword	ii
Abstract	iii
SECTION I	
INTRODUCTION	1
Overview	1
Background	1
The NOUFFSS Study	2
SECTION II	
PRESENT AND FUTURE NAVIGATOR-OBSERVER ROLES	4
Objective	4
Approach	4
Present Role	5
Factors Forcing Change	5
Future Role	6
SECTION III	
ANALYSIS OF REQUISITE OPERATIONAL TASKS	8
Objective	8
Approach	8
Products	9
SECTION IV	
DETERMINATION OF COMMON AND NON-COMMON TASK REQUIREMENTS	11
Objective	11
Approach	11
Summary of Findings	12
SECTION V	
DEVELOPMENT OF TRAINING BEHAVIORAL OBJECTIVES	14
Objective	14
Approach	14
Products	15
SECTION VI	
VALIDATION OF PRESENT TRAINING REQUIREMENTS	18
Objective	18
Approach	18
Summary of Findings	19
SECTION VII	
RECOMMENDED FOLLOW-UP	23
Objective	23
Sources of Follow-Up Recommendations	23
Follow-Up Recommendations	23
REFERENCES	28

SECTION I

INTRODUCTION

OVERVIEW

Navigator-Observer training presently is undergoing change. New and improved training innovations may be anticipated prior to 1975. Even more pronounced program changes will be required for the post 1975 timeframe with the introduction of new and vastly improved training systems and/or technological advances in new weapon systems.

The Navigator-Observer Utilization Field Flying Specialties Study (NOUFFSS) was designed to generate a solid foundation of information to be used for Navigator-Observer training philosophy, program design and research requirement amplification. Both the near term (1971 - 1975) and the future (1976 - 1990) were addressed.

Although NOUFFSS was a contract effort, it was performed in close concert with Air Training Command (ATC) - the ultimate user. Study procedures were designed to follow the Instructional System Development approach as presented in AFM 50-2 (Ref 1).

BACKGROUND

Factors contributing to the need for the study include:

Operational Requirements. The Navigator-Observer Utilization Field (AFSC 15XX) has evolved into a complex set of job types including the following four flying specialties:

- AFSC 1525 Radar Navigator
- AFSC 1535 Navigator
- AFSC 1555 Weapon System Officer
- AFSC 1575 Electronic Warfare Officer

Without analysis the flying specialties appear to have cohesiveness and continuity because they are in the same flying field. Indeed, there is some job similarity between the Navigator AFS and the Radar Navigator AFS. To some extent, job similarity extends through the Weapon System Officer AFS. However, there presently is little similarity between job requirements of these three AFSs and the Electronic Warfare Officer AFS. These relationships have complicated Navigator-Observer training.

Technological Changes. Rapid technology advances also have complicated Navigator-Observer training. Further advances will complicate training even more. Introduction of the B-1 strategic bomber, for example, will markedly alter the roles and tasks of SAC Electronic Warfare Officers and Radar Navigators. Phasing-out the F-4 weapon system will virtually eliminate the need for Weapon System Officers. Both factors will begin to impact in the late 1970s and early 80s.

Training Equipment. Significant changes may be anticipated in Navigator-Observer training equipment in the near future. New and more sophisticated training devices will be introduced, including: The Undergraduate Navigator Training System (UNTS) composed of the T-43 Navigator Training Aircraft and the T-45 Undergraduate Navigator Training Simulator; and the Simulator for Electronic Warfare Training (SEWT). Changing roles and tasks of the Navigator-Observer in the post 1975 timeframe may require additional training equipment introductions or modifications.

Utilization and Production. There are approximately 15,000 Navigator-Observers in the force. This figure includes all flying positions, command and staff positions, the supplement and the pipeline. Projected requirements through 1990 (Ref 2) indicated that a slightly increased number may be required. Consequently, training loads may remain at relatively high levels. As training costs rise, if only from inflation, it will become even more important to assure high quality and rates of training at reasonable and effective costs.

THE NOUFFSS STUDY

The study was designed to examine across-the-board requirements for Navigator-Observer training through 1990. Specific objectives were:

1. Determine present and future roles of the Air Force Navigator-Observer.
2. Identify and analyze requisite operational Navigator-Observer task requirements.
3. Determine which operational task requirements are common to a majority of Navigator-Observers, as well as those which are unique to each flying specialty.
4. Develop training behavioral objectives based upon both common and unique operational task requirements.
5. Validate present training requirements by comparing existing course training standards with the newly-developed behavioral objectives.
6. Identify where existing training information is inadequate and develop training research requirements.

With the resources available, the NOUFFSS study was designed to provide maximum support to Air Training Command in their continuing application of the ISD approach to the design of Navigator-Observer training. To maximize the support, the study was designed to accomplish some very specific objectives. In accomplishing the objectives, the study provided information for ATC use in effectively and efficiently bringing training fully into line with present and future requirements. Accordingly, the study emphasized:

- Definition of training requirements
- Development of training behavioral objectives

It should be clearly understood that the study was not intended to address the analysis of overall training system requirements, development of instructional tests, planning and validation of instruction, or conducting instruction. Subsequent training program design and implementation activities are required to accomplish these objectives and implement the balance of the ISD approach for Navigator-Observer training.

The following pages summarize significant aspects and findings of the study. Detailed information regarding all aspects of the study is presented in References 2, 3, and 4.

SECTION II

PRESENT AND FUTURE NAVIGATOR-OBSERVER ROLES

OBJECTIVE

Present and future roles of the Air Force Navigator-Observer were developed to provide information for training policy and philosophy decision making. Future role information also may be useful for structuring utilization and career plans.

APPROACH

Eight specific areas impacting upon present and future roles were analyzed: threat projections, weapon system technology projections, force projections, Air Force mission and role projections, mission scenario projections, operational environment projections, future need for navigators, and career factors.

Information for all areas was obtained, in part, through review of approximately 50 relevant technical and planning documents such as:

- Defensive Threat, Communist World (Refs. 6 - 9)
- Air Force Tactical Forces 1985 Study (Refs. 10 - 13)
- USAF Planning Concepts 1969 - 1984 (Refs. 14 & 15)
- The USAF Personnel Plan, Officer Structure (Refs. 16 & 17)

Working through key focal points, additional information was obtained through intensive interviews at Headquarters offices including the following:

USAF		ATC	SAC	MAC	
DPTTF	XODR	DON	DOT	DOF	
DPTBD	XOFS	XPT	DOTB	DOT	
DPXOE	XOOSLB	XPTM	DOTBB	DOTA	
OADT	XOOSN		DOTBG	DOQT	
PRMRO	XOOTR	MPC	DOTBP	DOXT	
RDPN	XOOTZE	DPMROR-4	DOTBT	DPX	
XODC	XOXF	DPMRCE-1-N	XPHN	DPAT	
TAC		ADC		AFSC	
DOA	DOXB	DOTEE	WGOOT-FT	DCS	XRTS
DOOT	DOXT	DOTVA	XPAS	XRLC	
DOR	DPAO-3	DOTVI	XPCE	XRLW	
DORT	DPX				
DOST					

Interviews also were conducted with project personnel at: Air Force Human Resources Laboratory, Air Force Avionics Laboratory, and B-1, F-111/FB-111, C-5 and AWACS SPOS.

Information thus obtained was analyzed to define the present Navigator-Observer role, identify factors forcing role changes, and develop future role projections.

PRESENT ROLE

The study indicated that operational utilization of the flying specialties is not in exceptionally close accord with the present AFSC breakout. The EWO presently has little, if anything, to do with basic navigation. Present utilization of Radar Navigators and Weapon System Officers also indicates that there is a high degree of job similarity between these positions. The F-4 and F-111 WSOs perform many tasks which are similar to those of the FB-111 RNs, and to some extent, the B-52 RN's tasks. All systems involve high and low level radar navigation and air-to-ground weapon delivery. In all but the B-52, operation of penetration aids and copilot duties are involved. Air intercept is performed only in the F-4.

Sophisticated technologies are impacting heavily upon RN and WSO jobs, particularly in the F-111 and FB-111. Roles in these systems are heavily oriented toward system management, monitoring and backup.

The AFSC 1535 Navigator's job is more in keeping with the traditional definition of navigator. However, technological advances are markedly affecting his role. Presently, his role is experiencing transition from the routinely manual navigation tasks performed in systems such as the C-130 or B-52, to system management, monitoring and backup tasks such as those performed in the C-5.

FACTORS FORCING CHANGE

Detailed discussion of factors impacting upon the Navigator-Observer's future role is presented in Reference 2. Highlights are summarized below:

Future Air Force missions and roles fundamentally will be extensions of present ones. Mixed forces of manned and unmanned systems will continue to ensure requirements for Navigator-Observers through 1990.

Technological changes will have the singularly most important impact upon future roles. Technology will work for the Navigator-Observer through improved automation, miniaturization, sensing, reliability and accuracies. Increased use will be made of automatic and semi-automatic penetration aids. Increased use also will be made of computer-based, aided, inertial navigation and weapon delivery systems with considerable programming flexibility. These trends will accelerate transition toward a role of system manager, monitor and backup.

The Navigator-Observer will not be totally replaced by sophisticated hardware systems, only assisted more by them. Tasks requiring interpretation of displays such as radar, infrared, and television will continue to require direct human involvement. Basic skills will be required to backup highly automatic systems.

Navigator-Observer training will become increasingly important. Projections for numerous basic avionics improvements indicate that system reliabilities will increase. In the event systems malfunction or fail, however, the Navigator-Observer will be required to accomplish the necessary tasks manually. Considering projections for increases in the threat and requirements for weapon system delivery accuracies, very meaningful questions will arise with respect to the amount and type of training which will be required to maintain manual skills at the necessary levels.

Manual backup task performance will be the pacing requirement. System malfunctions should occur only infrequently. Accordingly, opportunities for backup task practice may be minimal. Special training may be required to maintain backup task skills at required levels. This is typical of the problems presently experienced by many military and commercial pilots due to the extensive use of automatic flight control systems.

Impacts of these trends will become particularly evident in the late 1970s and early 1980s with the implementation of two primary force changes. First, the highly automated B-1 will be phased-in to replace the B-52. Second, the F-4 will be phased-out. Single-seat F-15 and AX systems probably will assume present F-4 missions. These changes will impact heavily upon two of the present AFSCs. Weapon System Officers will no longer exist as they are known today. Their remaining roles could be effectively filled by Radar Navigators. The role of the Electronic Warfare Officer also may be expected to change markedly as B-52s are replaced by B-1s. In the B-1, a navigation role for the EWO is likely to reappear. Plans for effectively retraining and utilizing present WSO and EWO skills will be required.

FUTURE ROLE

Flying Systems Officer (FSO) would be a classification more in keeping with future role-related requirements than would the anachronism of Navigator-Observer. Projections for the late 1970s and early 1980s strongly indicate the desirability of such a change.

Such a change might also be accompanied by replacement of the term "pilot" with a more role-related concept such as Control Systems Officer (CSO). In addition to providing more role-related categories for flying specialty classification, it is quite probable that the new categories and titles would enhance crew integration and team cooperation because of the new "flying crew" image which could be promoted.

A possible FSO flying specialty breakout is presented as a broadly defined interpretation of the future role of the 15,000 managers, monitors and backups for future navigation, penetration and weapon delivery systems.

Navigation Systems Officer (NSO). The NSO would be qualified to navigate on a world-wide basis. Additionally, he may be required to possess the necessary knowledges and skills to perform sector patrol or other station keeping and orbiting tasks, accomplish air refueling intercepts, or accomplish combat air drop navigation tasks. ECCM skills may be required.

Offensive Systems Officer (OSO). The OSO would be qualified to navigate on a world-wide basis, including low-level navigation through hostile areas. He also would be responsible for the delivery of a variety of air-to-ground weapons ranging from standoff missiles to gravity drop devices. Depending upon the weapon system to which he is assigned, he may be required to perform duties including penetration aids management and copilot tasks.

Defensive Systems Officer (DSO). The DSO would be qualified to navigate on a world-wide basis, including low-level navigation through hostile areas. He would manage a variety of penetration aids devices ranging from onboard equipment to special purpose expendables and missiles.

Role information, alone, does not provide sufficient detail for future training program design. Detailed analysis of present and future operational task requirements is needed to provide a solid foundation for program planning. The following sections expand upon present and future role definitions by addressing the analysis of present and future requisite operational task requirements, and the extent to which the requirements are common or unique across a wide spectrum of mission and weapon system types.

SECTION III

ANALYSIS OF REQUISITE OPERATIONAL TASKS

OBJECTIVE

This phase of the NOUFFSS study was designed to obtain a complete inventory of the operational task activities required by each of 14 different navigator (15XX) crew positions. In accomplishing the objective, content for a computer-ready task data base was developed and delivered to ATC for continuing expansion and application to training program design. Data base content was used in the study to determine which task requirements are common to many navigator positions, as well as those which are highly unique to the various flying specialties.

APPROACH

Eleven weapon systems representing 14 different navigator crew positions were selected for analysis in the study. In this respect, NOUFFSS was a sampling study; all Air Force navigator crew positions were not analyzed. Weapon systems and crew positions selected for analysis are shown in Table 1.

The sample was carefully selected to provide a broad, representative sample of present and future operational task requirements. Projections of the future role of the Air Force navigator played an important part, as did force structure projections (Refs. 2, 18 and 19). Requirements to include the greatest number of navigators and a representative sampling of the flying specialties within the resources of the study also influenced selection of the sample. Future systems (B-1 and AWACS) were included so that implications of the latest technology would be considered. In these ways, both present and future training needs were taken into account.

Table 1. Weapon Systems and Crew Positions Sample.

Crew Positions	AWACS	C-54	C-141A	C-130E	RF-4C	F-111A	F-4E	KC-135	B-52G	B-1	FB-111
NAV	X	X	X	X	X			X	X		
WSO						X	X				
RN									X	X	X
EWO									X	X	

Mission scenarios were developed for each weapon system (Ref. 2). Based upon the scenarios, gross job descriptions (Functions) were identified. Functions were then refined for each crew position by identifying all operational tasks required for mission accomplishment by each crewmember. Tasks were further refined by identifying sub-tasks (job elements) required for task accomplishment. Command and staff functions were not addressed.

Task data were developed through a three-step process. First, study team members identified task requirements in a preliminary fashion. Next, team members intensively interviewed weapon system navigators for each of the operational systems shown in Table 1. Third, simulator and inflight observations were made when practical.

Approximately 100 operational navigators were interviewed during the process. The interviews and observations ensured that the newly-developed task analysis data were in keeping with everyday, real-world operational requirements. The task analysis methodology is fully described in Reference 3.

B-1 and AWACS systems are not yet operational. For these systems, team members relied upon published system design documents and interviews with SPO and contractor R&D personnel.

The study used extensions and refinements of established task analysis methods (Refs. 20, 21, 22 and 23). The extensions and refinements were required because the study posed strict and uncommon requirements for highly standardized task descriptions and analyses. These stemmed from the need to identify common and uniquely detailed task requirements across a broad and diverse sample of crew positions.

To accommodate these requirements, highly standardized catalogs of task description and analysis information were developed. The catalogs were pivotal to the success of the effort. Their content had to encompass the requirements of 14 different aircraft-crew positions, while at the same time providing the necessary level of detail for subsequent training analysis activities. The catalogs were used throughout the development of the Navigator-Observer task analysis data base.

PRODUCTS

A Navigator-Observer task analysis data base was the end product of this phase of the study. The data base presented comprehensive descriptions and analyses of all of the operational, mission-related task requirements for each of the 14 crew positions in the study sample. The data base was keypunched for computer use and has been delivered to ATC.

The data base has many uses. It was used during a subsequent phase of the NOUFFSS study to determine common and unique task requirements. Additional, future uses include: the design of training tasks, selection of methods and media, development of student selection criteria, and development of detailed performance measures and tests. Other applications are discussed in References 4 and 5. To maintain its viability, however, the data base will require periodic updating and expansion.

SECTION IV

DETERMINATION OF COMMON AND NON-COMMON TASK REQUIREMENTS

OBJECTIVE

This activity was designed to identify task requirements which were common across the total sample of crew positions, missions and systems, as well as those which were unique to the various flying specialties, weapon systems and missions. The analysis of common and unique tasks was performed in a manner which allowed for the identification of task requirements which would be common throughout the 1971 - 1990 timeframe, as well as those which would not be.

APPROACH

Two separate analyses were used to identify common and non-common tasks. Commonalities among task data were determined across the entire sample of 14 crew positions. Commonalities among task data also were determined separately for each AFSC (e.g., just Navigators, just Radar Navigators, etc.) Resulting information identified task requirements which were either common or unique with respect to all Navigator-Observers, as well as those which were either common or unique with respect to each AFSC, weapon system or mission.

Identification of common and unique task requirements dealt with the total 1971 - 1990 timeframe. The total timeframe was divided into four units of five years each. The commonality analyses identified above were completed independently for each five year timespan. Results of this approach allowed for the longitudinal examination of common and unique tasks, and provided information regarding how long various task requirements would remain common.

Computer methods were used to identify common and unique task requirements. Information from the Navigator-Observer task data base were input to the computer. Computer output identified the total percent of Navigator-Observers performing each of 446 different operational task requirements. A task commonality factor of 100% indicated that all Navigator-Observers in the study sample performed the task requirement. A factor of 20% indicated that only one in five performed the task, etc. Separate computer output was obtained for each of the commonality analyses in each of the four timespans comprising the 1971 - 1990 period.

The composite of the commonality analysis information provided the means for identifying task requirements which were broadly applicable to many Navigator-Observers, those which were more highly weapon system specific, and those which were highly

AFSC specific. Trends in the information could be traced over the entire 1971 - 1990 timeframe. With this knowledge, training behavioral objectives could be developed accordingly.

SUMMARY OF FINDINGS

Results of the computer-based task commonality analyses were virtually identical for each of the three timespans comprising the 1971 - 1985 time period. Accordingly, results of the analyses were combined over this time period.

Commonality analysis results for the 1986 - 1990 timespan were similar to those of the preceding time period. However, the 1986 - 1990 results were based upon considerably fewer data. This occurred because types and numbers of aircraft in the inventory during 1986 - 1990 are less well defined. Many replacement aircraft also are not yet identifiable. As a result, operational task requirements are less well defined, and results of the commonality analysis for this timespan were less stable.

Three distinct task commonality clusterings were apparent throughout the 1971 - 1985 time period. A relatively large number of task requirements (40%) were found to have low commonalities (1% - 19% commonality factors). Task requirements falling in this low commonality cluster were highly weapon system specific, indicating a continuing need for strong Combat Crew Training Squadrons (CCTs) and on the job training.

Approximately 30% of all task requirements fell in a moderate commonality cluster (20% - 49% commonality factors). Task requirements in this moderate commonality cluster were highly mission specific, indicating a continuing need for strong schools such as NBT and EWOT.

The remaining 30% of all task requirements fell in a high commonality cluster (50% - 100% commonality factors). Task requirements in this high commonality cluster reflected broad-based operational requirements. Such task requirements should be primary candidates for incorporation into UNT.

Composition of the commonality clusters may be expected to remain relatively stable through 1985. However, detailed task requirements are dynamic and will change from time to time as mission requirements change, as new systems are introduced, and as new equipments are retrofitted into existing systems. This, coupled with uncertainties in projecting task requirements from 1986 - 1990, is further evidence that the Navigator-Observer task data base should be periodically updated. The existing data base, along with commonality analysis computer programs, have been provided to ATC. All of the basic tools are available to re-run the commonality analyses at later dates and with updated information.

Results of the commonality analyses were used extensively in translating operational task requirements into training behavioral objectives. The procedure is addressed in the next section.

SECTION V

DEVELOPMENT OF TRAINING BEHAVIORAL OBJECTIVES

OBJECTIVE

The objective of this aspect of the NOUFFSS study was to develop training behavioral objectives based upon operational task requirements. Behavioral objectives are generally-stated end products of training. In keeping with the three task commonality clusters, separate families of behavioral objectives were developed for: general training program design, mission-oriented training program design, and weapon system-specific training program design.

APPROACH

Only one study (Ref. 21) had previously addressed the development of behavioral objectives based upon computer analysis of task commonalities across a sample of diverse operational requirements. The NOUFFSS study expanded upon methods used in the previous study through the development of a specifically tailored method for translating common and unique task requirements into behavioral objectives.

The method consisted of an eight-step decision logic which is fully discussed in Reference 4. The method involved use of the standardized task description and analysis catalogs, computer output from the commonality analyses, and future Navigator-Observer role projections.

Prior elements of the study generated information which made possible the development of training objectives beyond the behavioral objective level. To provide the training program designer with the maximum information available, near-criterion objective statements (Ref. 1) were developed.

Criterion objectives require detailed statements of the behaviors which must be performed, the conditions under which the behaviors must be demonstrated, the standards of performance which must be displayed, and criterion tests for measuring the behaviors. The near-criterion objectives developed during this study excluded only the criterion tests.

In keeping with the philosophy of summarizing and conveying maximum information, the near-criterion objectives developed during the present study also contained the following information: related task analysis data references, approximate commonality factors of relevant task data, related course training standard titles and numbers, and results of the training assessments as addressed in the following section. The expanded behavioral objective content provided a more solid foundation of information to the Navigator-Observer training program designer.

PRODUCTS

Forty-Eight behavioral objectives were developed. Of these, 23 represented high commonality training requirements, 16 represented moderate commonality training requirements, and the remaining 9 represented low commonality training requirements.

An example behavioral objective is presented in Figure 1. All abbreviations and content in the example are defined below.

CRIT. OBJ. ORIGINS: TASKS, SUBTASKS. These entries present numeric codes of the task data from which the behavioral objective was developed.

WPN. SYS. This entry identifies the weapon systems associated with the task data.

OBJECTIVE REQUIREMENT: NEW, PAR. VAL., VAL. This entry identifies the extent to which the behavioral objective validated an existing course training standard. The three categories are: new, partially validated, and fully validated.

APPROX. COMMONALITY. This entry identifies the approximate commonality factor for the contributing task data.

C.T.S. NO. This entry presents a numeric code for the course training standard used in the validation comparison.

C.T.S. DESCRIPTION. This entry presents the title for the course training standard used in the validation comparison.

OBJECTIVE TITLE. This entry presents a brief descriptive title for the behavioral objective.

CONDITIONS. This entry describes the operationally-based environmental conditions under which a student should be able to demonstrate performance of the behavioral objective content.

BEHAVIOR. This entry operationally describes the behavioral outputs required by the student in order to demonstrate skill and knowledge proficiencies required by the overall behavioral objective.

STANDARDS. This entry presents required performance standards which the student must meet while demonstrating required behavioral outputs.

PREREQUISITE SKILLS AND KNOWLEDGES. This entry summarizes skill and knowledge requirements obtained from the task analysis data.

CRIT. OBJ. ORIGINS: TASKS 003, 004, 006			
SUBTASKS 014, 015, 016, 018, 019, 020, 022, 025			
WPN. SYS. Total NOUFFSS sample except C-5			
OBJECTIVE REQUIREMENT:	NEW	PAR. VAL.	VAL. X
APPROX. COMMONALITY	85%	C.T.S. NO.	U1, U4, U5 U16, U24, W11
C.T.S. DESCRIPTION	See Section V, Part II for corresponding CTS titles (Ref. 4).		

OBJECTIVE TITLE: Perform Mission Planning and Chart Preparation
CONDITIONS(S): Student has received mission order and/or mission briefing for a high-low-high over land and water mission to a distant Air Force Base. He is provided with working space suitable for flight planning.
BEHAVIOR(S): Student plans the required mission, preparing all necessary charts, flight planning forms and required local forms
STANDARD(S): Selects appropriate charts; verifies currency of planning documents; identifies destination, alternatives, restricted areas, suitable enroute CP coordinates (± 0.5 min.); interprets enroute wind & weather data; plots course (± 2 deg.); determines headings and mag. var. (± 2.0 deg.); computes ETAs (± 2.0 min.); determines required fuel ($\pm 5\%$), correct altitudes, radio nav. & comm. frequencies; correctly annotates charts and completes celestial precomputations as required.
PREREQUISITE SKILLS AND KNOWLEDGES: Use of charts, flips, notams, supplements, sigmets, mission weather forms, letdown plates, flight plan forms; military, FAA, ICAO, & Local regulations; mission planning procedures; weather interpretation; aircraft performance profile; HO-249; use of radio nav aids and onboard computers & radars; fuel consumption characteristics; celestial navigation.
SUPPORTING SUBTASK BEHAVIORS: 001, 002, 004, 005, 008, 009, 010, 017, 021, 023, 024, 031, 033, 369, 370, 372, 378, 379
COMMENT(S): Measurement of performance, including planning time, requires development of a "test" mission.

Figure 1. Example Behavioral Objective.

SUPPORTING SUBTASK BEHAVIORS. This entry presents numeric codes for other, indirectly related task analysis data.

COMMENTS. This space provides for notation of exceptions, deviations and alternatives applicable to all of the preceding entries.

Training must be dynamic in response to changing operational task requirements. The development of behavioral objectives is not a one-time thing. As pointed out previously, the objectives have been based upon operational task requirements. Such requirements are dynamic and subject to change. Additionally, it may be desirable to employ different commonality clustering techniques. If this is done, content of the behavioral objectives may be expected to change responsively.

Behavioral objectives developed during this phase of the study provided the baseline information against which present training requirements were validated. Validation procedures and results are summarized in the next section.

SECTION VI

VALIDATION OF PRESENT TRAINING REQUIREMENTS

OBJECTIVE

This phase of the study validated present training requirements by comparing existing course training standards with the newly-developed Navigator-Observer behavioral objectives. This phase determined the degree to which present course training standards (training requirements) met the study-derived behavioral objectives, and provided insights into the need for future course revisions.

APPROACH

All study-derived behavioral objectives and supporting data are presented in Reference 4, along with the course training standards which were used for the comparisons.

Current course training standards for the following schools were used: Undergraduate Navigator Training (Ref 24), Navigator-Bombardier Training (Ref 25), Electronic Warfare Officer Training (Ref 26), and F-4 Weapon System Officer Training (Ref 27). F-4 course training standards were selected for the comparisons because F-4 WSOs account for practically all Weapon System Officer crew positions addressed in the study.

Behavioral objectives were developed from task analysis data. They represented a combining of task data across as many as 14 crew positions from 1971 - 1985. In validating present training, the total content of each behavioral objective was compared with the total content of each course training standard.

The validation process was influenced by inherent differences in content and nature between behavioral objectives and course training standards. Behavioral objectives require the objective specification of observable, measurable behaviors, along with the conditions under which the behaviors must be demonstrated and the measures and criteria of acceptable student performance. Course training standards, on the other hand, do not contain all of this content. In part, this is to be expected since course training standards have not been developed in strict accordance with the relatively new requirements of AFM 50-2. The net result is that 100% full validation is, for all practical purposes, impossible. The reader is reminded, therefore, that results of the validation of present training requirements are on the conservative side. Detailed and indepth comparisons of study-generated behavioral objectives with actual training content might increase the extent to which present training requirements would be fully valid. Such indepth comparisons were beyond the scope of the present study, however.

Five categories of validation were used. FULL VALIDATION indicated that a course training standard fully covered all of the training content of a behavioral objective. PARTIAL VALIDATION indicated that a course training standard only partially covered the training content of a behavioral objective. If a course training standard was unrelated to any behavioral objective, then it was rated as NOT VALIDATED. If a behavioral objective had no direct counterpart in any course training standard, then the behavioral objective reflected a NEW training requirement.

Finally, the category of NO DIRECT OPERATIONAL EQUIVALENT was used. This category identified course training standards which were judged to represent training enabling objectives (preliminary learning tasks) rather than directly operational, job-related requirements. A NO DIRECT OPERATIONAL EQUIVALENT rating does not mean that a course training standard should not be taught. Rather, the rating simply identifies preliminary learning task course training standards and distinguishes them from validated or partially validated, operationally-oriented standards.

SUMMARY OF FINDINGS

Table 2 summarizes results of the validation comparisons. Trends in the results should have special significance to the training program designer, particularly in the context of AFM 50-2.

Eighty-one course training standards were identified. Of these, 81% were supported by the study-derived behavioral objectives. Approximately half of the course training standards were fully validated. An additional one third may only require modification to bring them fully in line with operational requirements through 1985.

The remaining 19% of course training standards were not supported by study-derived behavioral objectives. No direct operational equivalents were identified for 16% of the course training standards. As indicated earlier, standards falling in this category were judged to represent preliminary learning tasks rather than end product training objectives. An example of such a course training standard is: "Principles of bombing."

Only 2% of the course training standards fell in the not validated category. These were: "Aural code" and "Use of AN/ASQ-38 inflight maintenance manual."

Only 1% was categorized as an exception. The single exception was: "Current airborne electronic reconnaissance vehicles and systems." Electronic intelligence task requirements were not addressed in the study, and no attempt could be made to validate this standard.

Table 2. Summary of Course Training Standard Validations
Against NOUFSS-Generated Behavioral Objectives.

Schools	Total Number of CTSS*	Fully Validated CTSS	Partially Validated CTSS	No Direct Operational Equivalent	Not Validated	Exceptions
UNT	27	9 (33%)	12 (44%)	5 (19%)	1 (4%)	0 (-)
NBT	12	8 (67%)	2 (17%)	1 (8%)	1 (8%)	0 (-)
EWOT	20	9 (45%)	3 (15%)	7 (35%)	0 (-)	1 (5%)
WSOT (F-4)	22	13 (59%)	9 (41%)	0 (-)	0 (-)	0 (-)
TOTALS ACROSS ALL SCHOOLS	81	39 (48%)	26 (33%)	13 (16%)	2 (2%)	1 (1%)

NOTE: Percent equivalents are shown in parentheses.

*CTSS is the abbreviation for course training standards.

Trends in the validation results were highly similar across all ATC and TAC schools which were addressed.

For UNT, 77% of all course training standards were fully or partially validated. An additional 19% were judged to reflect preliminary learning tasks. Only one UNT standard was not validated.

For NBT, 84% of all course training standards were fully or partially validated. An additional 8% were judged to reflect preliminary learning tasks. Only one NBT standard was not validated. Specific training content for a number of NBT standards may require revision during the late 1970s to early 1980s, however. This will be caused by the eventual phasing out of the B-52 weapon system and phasing in of the B-1 system.

For EWOT, 60% of all course training standards were fully or partially validated. An additional 35% were judged to reflect preliminary learning tasks. No EWOT standards were found to be invalid. One standard dealing with electronic intelligence was not validated. The NOUFFSS study did not deal with electronic intelligence, and validation was not possible. A number of EWOT standards also may require revision as B-1 weapon systems are phased in.

All of the F-4 WSO course training standards were fully or partially validated.

All validation comparisons assumed that the study-generated behavioral objectives 100% validly stated all Navigator-Observer training requirements. However, training analysis remains a soft and subjective art. Validation results, therefore, must be interpreted in this light.

Not all study-generated behavioral objectives represented the same degree of training content. Similarly, existing course training standards also represented differing degrees of training content. For example, there are 22 standards just for F-4 WSO training; there are only 12 for all of NBT. The net result is that no direct correlations may be made between degrees of course training standard validation and degrees of training time, resources or costs needed to bring all training into full alignment with present and future requirements. This is an additional matter which the NOUFFSS study was not tasked to address.

All validation comparisons were made in the context of present course training standards. Future revisions of the course training standards should be contrasted with study-derived behavioral objectives to ensure that training is highly geared to operational task requirements.

Finally, the present validation results in no way represent a validation of present ATC navigator training program structure nor do they invalidate the present structure. Total program structure is an independent matter. The NOUFFSS study was not tasked with designing the optimum flow of all Navigator-Observer training.

SECTION VII

RECOMMENDED FOLLOW-UP

OBJECTIVE

Recognizing that requirements for meaningful follow-up activities frequently fall out of a NOUFFSS-type study, the final objective was to identify areas where further studies are needed to improve present Navigator-Observer training programs and achieve future training program objectives.

SOURCES OF FOLLOW-UP RECOMMENDATIONS

Follow-up recommendations were developed from three primary sources. First, the study was not tasked to address all of the steps in the Instructional System Development approach as presented in AFM 50-2. In the steps which were addressed, requisite operational task requirements and associated training behavioral objectives were emphasized. Accordingly, additional activities are required to fully implement the ISD approach to Navigator-Observer training.

A second source was the interviews which were accomplished during the study. Persons interviewed included Headquarters personnel, operational Navigator-Observers, and R&D project personnel. A range of real-world follow-up topics became apparent throughout the interviews.

A third source was the technical hurdles encountered in accomplishing study objectives. A number of fundamental, state-of-the-art problems were encountered, particularly in the area of training analysis. As a general rule, for example, it was found that sound training program development philosophies exist. However, objective, practical, validated tools for implementing many aspects of the philosophies remain to be developed.

FOLLOW-UP RECOMMENDATIONS

Detailed follow-up recommendations are presented in Reference 5. The recommendations presented in this document were derived from the content of Reference 5 with emphasis upon the following criteria:

- They should reflect recommendations for user efforts to assure that products of the present study have long-term utility.
- They should reflect topics of high potential payoff in terms of enhancing Navigator-Observer training efficiency and effectiveness.

Follow-up recommendations presented in this report are further categorized according to a structure of Air Force organizations which, in the judgment of the authors, would benefit most from pursuit of the follow-up activities.

AIR TRAINING COMMAND FOLLOW-UP RECOMMENDATIONS

A Navigator-Observer task analysis data base now exists. The data base should be implemented in a computer system to make the content readily accessible to training program designers. Additional information requirements of program designers should be identified. Content of the data base should be expanded to incorporate the requirements. Anticipated requirements include: training device selection criteria, training sequencing information, detailed testing and measurement tools, and task cueing information (stimulus or initiating condition information).

A requirement also is anticipated for broadening the data base. Task requirements for only 11 weapon systems were analyzed in the present study. Although the sample reflected Air Force requirements, by no means did it exhaustively address all requisite operational task requirements. It is recommended, therefore, that task analysis data for other weapon system crew positions be added to the data base to ensure that a broad-based pool of information is provided for ATC training program designers. A broader information base would ensure that ATC training programs would further enhance their responsiveness to operational user requirements.

Training criterion objectives are required. The present study was tasked only with the development of behavioral objectives. Although the behavioral objectives were supplemented by information over and above that typically required of behavioral objective statements, the total content of criterion objectives was not addressed. In particular, highly detailed performance measurements and student performance tests were not defined. Accordingly, a requirement exists to pursue detailed performance measurement, and to define testing and measurement devices, and procedures for measurement. Accomplishment of these requirements is needed before training criterion objectives can be developed in the context of AFM 50-2.

In light of anticipated changes in the role of the Navigator-Observer in the late 1970s, there is ample reason to recommend that total Navigator-Observer training system organization and structure should be examined. Cost-effectiveness models should be developed and exercised to ensure maximum training effectiveness in the context of anticipated new roles. The existing task analysis data base would be valuable to this developmental topic.

An orderly plan also is needed to structure the transition to new RN and EWO roles and task requirements such as those which will be imposed by the B-1 weapon system introduction.

JOINT ATC/AFHRL FOLLOW-UP RECOMMENDATIONS

It is impossible to know the degree of training effectiveness without comprehensive, objective performance measurement. A need exists for comprehensive and indepth analysis of operational task performance measurement requirements. A need also exists for developing methods of translating operational performance requirements into training performance standards. For example, setting student standards too high can unduly prolong training and inflate training costs. Setting them too low can result in inferior skills.

Navigator-Observer proficiency maintenance requirements and methods also require examination. This is particularly so with respect to continuation training. It is anticipated that the Navigator-Observer supplement will increase. As a result, removal from operational, mission-related flying will increase. Measurement of proficiency maintenance will become even more important in this context.

A method is needed to comprehensively relate performance measurement requirements to training device selection and use, including comprehensive, computer-based measurement and assessment. A method is needed to ensure continuity in performance measurement throughout training to ensure compatible measurement in operational assignments. This is needed to ensure efficient and objective measurement of transfer of training and, therefore, training effectiveness.

In the context of measurement, a study should be undertaken to examine the number of learning trials required to achieve proficiency. Such a study could provide information which would significantly shorten the amount of time spent in training certain skills by empirically assessing when suitable skill levels had been met. Selection of appropriate tests and devices for measuring skill attainment should be included in the study.

Individualized instruction is highly emphasized at present. Hard data are lacking, however, for determining which tasks are most suitable to individualized instruction and which devices and techniques, such as computer-aided instruction and simulation, could be most effectively used. It is recommended, therefore, that an investigation of optimum use of individualized instruction and simulation be undertaken. Results of the study should provide hard data for determining optimum utilization of learning center and simulation capabilities in relation to learning task requirements.

One of the alternatives within the exploration of optimized training program structure should be the examination of a pre-UNT familiarization course for both preliminary training and student final selection. Training costs for Navigator-Observers could be reduced by weeding out potential failures during such a course.

Navigator-Observer student selection devices and criteria merit careful review, analysis, evaluation and updating. Entry level skill and knowledge measurement devices, including the AFOQT, merit objective and empirical examination. The selection or development of new measurement devices should be empirically tested. Once student candidates have been selected, devices for careful screening of students for indepth training also should be evaluated. A pre-UNT course should be given consideration in this light.

A study is recommended to examine the future roles and tasks of Navigator-Observer instructors. The objective of such a study should be the development of devices and criteria for selecting and training instructor candidates. Limited use of civilian instructor personnel should be considered as one alternative.

A study also is recommended to establish optimum measurement devices and criteria for assigning UNT graduates to subsequent training programs and operational assignments. Evidence exists to indicate that UNT graduates may not be universally assignable, due primarily to their own capabilities and desires. Devices and criteria for graduate assignments are required to ensure maximum utilization of skills while enhancing Air Force career opportunities and Navigator-Observer retention.

JOINT USAF/ATC/AFHRL FOLLOW-UP RECOMMENDATIONS

Training analysis is, by definition, a methodologically-based procedure. Methodologies constitute training analysis working tools. Yet, well developed and explicitly stated tools do not exist for implementing many aspects of the Instructional System Development approach as presented in AFM 50-2. The development and validation of training analysis tools has application beyond Navigator-Observer training to pilot training and technical training. Basic methodological developmental topics are recommended in several areas, including those identified below.

Development and evaluation of improved methods for determining criterion objective (training end products) and enabling objectives (learning tasks) are required. Basic methods for defining and interrelating enabling objectives and criterion objectives also are needed. Only philosophy exists today. Means for implementing the philosophy are lacking. Implementation of the requirements of AFM 50-2 may suffer accordingly.

Development and evaluation of improved methods for translating operationally-based task behaviors into training-oriented behaviors are required. The present study attempted to further the state-of-the-art in this area. However, further strides must be made to ensure development of methods and procedures which can be reliably followed by the broad spectrum of individuals who are involved in training program design.

Development of strategies and methods for optimally using university-developed learning theory concepts also should be pursued because of their broad applicability to training program design. Typically, there has been a gap between university-type research and operationally-based requirements. It is recommended, however, that the latest laboratory research findings in the area of learning theory be reviewed and integrated for application to optimized Air Force training program design.

Finally, the area of Navigator-Observer self concept requires examination with the objective of enhancing perceived self-actualization. As stated previously in this report, it is recommended that the anachronism "Navigator-Observer" be replaced with the more role-related title of Flying Systems Officer. It also was suggested that the title "pilot" be replaced with the more role-related concept of Control Systems Officer. A study should be undertaken to examine the benefits which might arise from such changes in terms of enhancing the flying crew image and promoting perceptions of self-actualization.

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13. ABSTRACT The Navigator-Observer Utilization Field Flying Specialties Study was performed in the context of the Instructional Systems Development (ISD) approach. The study was designed to identify the future role and training requirements for Navigator-Observers through 1990. Objectives accomplished by the study were: <ul style="list-style-type: none"> - Determine present and future roles of Navigator-Observers - Identify and analyze operational task requirements - Identify common and non-common operational tasks - Develop training objectives based upon all tasks - Validate present Navigator-Observer training requirements - Identify further research and development requirements Role information was used in the development of behavioral objectives for projected training tasks. Role information can also be used in policy decisions regarding future navigator training program design. Task and commonality analysis data formed the nucleus of the first computerized navigator-observer data base. Among the most important uses of such information are the development of trainee selection criteria, design of training tasks, curriculum design, selection of methods and media and development of detailed performance measures and tests. Training requirements in the form of behavioral objectives can provide the cornerstone for future Navigator-Observer training program design according to ISD. Approximately 80% of present Navigator-Observer training requirements were partially or fully validated by study derived data. Recommendations for follow-up studies are presented.		

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